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THE OPERATION OF THE MOLINE FILTRATION PLANT[1]

By A. E. Anderson

This plant is municipal property, and is situated on the bank of the Mississippi River. It is 242 feet in length and 76 feet deep, faces the river on the north and supplies a city of 35,000 inhabitants. It has a Jewell system of sedimentation and filtration, a pumping capacity of 20,000,000 gallons per twenty-four hours, filtering capacity of 5,000,000 to 6,000,000 gallons, and reserve of 1,000,000 gallons. The western portion of building is occupied by the boiler and locker rooms, the central portion by engine and tool rooms, and the eastern portion by sedimentation and filtration room, laboratory, meter room, alum storage.

Boiler room. This is equipped with two Aultman-Taylor Illinois stoker feed boilers of 150 horse power each and two Keeler boilers of 200 horse power each, hand stoked and fitted with Palmer forced draft. There are two Worthington duplex boiler pumps and one Blake & Knowles 1,000-horse power open heater. The water is heated as a rule to 190° Fahr.

Raw water supply. The water is obtained from the two channels of river, which branches on account of a dam extending $2\frac{1}{2}$ miles upstream from the eastern point of the Government Arsenal, an island directly opposite Moline. This dam was built to increase the head 5 feet between the Arsenal and Moline in order to supply water power for the Arsenal and local electric plants situated a mile downstream.

Intakes. These are two in number, one 18 inch extending 3280 feet northeast to the main river channel, the other a 20 inch extending 1200 feet due north to the channel of the water-power branch. The water enters the plant by gravity. These intakes are equipped with a compressed air connection to blow away any obstruction such as ice which may threaten to shut off the supply.

Raw water reservoir. This is located beneath the floor in the northwest corner of the engine room. It has a depth of 20 feet and a capacity of 90,000 gallons. The head of water here varies with the river stage because of its flowing in by gravity.

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[1] Read before the Illinois Section on March 25, 1919.

Low-lift pumps. These are two in number and lift the water to basins 75 feet to the east. The lift varies from 16 to 26 feet, depending on the river stage.

One of these pumps is situated in the northeast corner of the engine room, half way between the raw-water reservoir and the basins. It is a single-stage, centrifugal pump having a capacity of 5,000,000 gallons per twenty-four hours. It is driven by a double-wheel water motor, the actuating water being taken off the high-service main at 100 to 110 pounds. This water flows back to the clear-water reservoir.

The other pump is an auxiliary used only at times of heavy demands. It is a Worthington double-stage centrifugal pump driven by a Kerr steam turbine, and has a capacity of 6,000,000 gallons per twenty-four hours. It is located in a pit 12 feet below the engine room floor and 4 feet east of the raw-water reservoir, making a suction lift of 0-8 feet; at high water there is practically no lift. The first-mentioned pump has a suction lift of 12 to 18 feet. This Worthington pump is connected to the 18 inch main and can pull directly from the main channel or reservoir as desired.

Alum introduction. The alum can be introduced in any one of three ways, by pump, suction or siphon. The pump discharges the alum into the raw water main at a point 50 feet from the basins. The suction line is attached to the suction lifts of both low-lift pumps. The siphon will discharge the alum charge at the same point as the pump or at the weir where the water flows over to the filters.

Alum tanks. There are two of these, from which the charge is pumped, suctioned or siphoned. They are concrete, 12 feet in diameter, 10 feet deep, and located in the southwest corner of the filtration room. The alum is dumped into a solution tank located between the two main tanks. The water is turned in at the bottom of the solution tank and the charged solution flows through a strainer at the top into either tank. The latter are equipped with float gauges.

Alum pumps. There are two alum pumps, each having a capacity of 40,000 gallons per 24 hours. They are water-motor, centrifugal pumps operated by pressure from the high-service main, the water used flowing back to the clear-water reservoir. These pumps are located beneath the floor 50 feet north of the alum tanks and 15 feet east of the point of alum introduction.

Suction lines. These are beneath the floor and, as above stated, discharge alum solution into the suction lines of both low-lift pumps.

Siphon. This is an emergency means of supplying the alum. It is used chiefly by operators to increase the floc on the filters, to insure having a sufficient mat on the beds, when for any reason the floc is coming over the weir to the filters in insufficient amounts. This siphon can also be used in case of emergency for hypochlorite of lime treatment.

Basins. The water, after being dosed with alum, enters two basins, separated by a concrete wall to permit washing one at a time. They are 50 feet long, 32 feet wide and 20 feet deep and extend 8 feet above the floor level. Both the basins and filters are surrounded by a railed walk. Each basin is subdivided into five smaller ones, each 10 feet wide and 32 feet long. These divisions are made by wooden baffles, which have 6 x 24-inch openings 6 inches apart from top to bottom. The baffles, having these spaces at opposite ends, cause the water to take a zigzag course. Each basin has a capacity of 240,000 gallons. The average period of sedimentation is one and one-half hours. The basins are washed every month, treated water being used.

Weir. After sedimentation in these basins the water flows over a weir in the last sedimentation basin into a 24-inch main which feeds all filters. Each filter has a 10-inch connection at the center, which branches to an 8-inch extending to the sides of the filter, with the exception of filters 1 and 5, where the connection extends but to one side.

Filters. These are located directly back of the settling basins. They are five in number, 12½ feet wide, 33 feet long and 9 feet deep. Running through the center lengthwise at the bottom is a 12-inch main with 1½-inch pipes extending at right angles to each side of the filter. These are placed 6 inches apart the full length of filter. On these 1½-inch pipes, at a distance of 4 inches apart, are Jewell Pittsburg strainers. Directly above this center main at the bottom and 25 inches above the sand level is an 8-inch air pipe having eight 2-inch connections extending down to the bottom main. Through this the filters are given an air blow, usually three to five minutes three times a week.

The filters have 12 inches of graded gravel and 30 inches of Red Wing sand.

The wash troughs for each filter are two in number, located at the sides. They are 12 inches wide and 20 inches deep.

The wash water used is pumped from the clear-water reservoir by a 60-horse-power Erie engine, aided at the present time by some pressure from the high service main. There is a rise of 14 inches per minute through the sand and it is customary to use about 30,000 gallons per ten minutes. The controllers are fitted with two discs, a large disc giving a flow of 1,000,000 gallons for 24 hours and a smaller disc allowing 200,000 gallons more per filter or a total for the five filters of 1,000,000 gallons more per 24 hours. Experiments are now being carried out to ascertain if there is any appreciable difference in the quality of the filtered product.

Float loss-of-head gauges used. When starting a filter, the water is allowed to stand quiescent on the bed for 15 to 30 minutes, and the effluent is then run to waste for 5 minutes, in order to bring the mat down firmly on the sand before water is turned into the clear-water basin.

Controllers. These are the Jewell four-valve float type and, as already stated, have two discs, the large telescoped over the small, thus permitting a change in five minutes to either disc desired.

Chlorination. The water after leaving the filters passes into a 24-inch main which extends north 15 feet to the clear-water reservoir, entering at the bottom. Just before entering, it is chlorinated.

A Wallace & Tierman manual-control solution feed, type B apparatus has been used; an automatic apparatus is now being installed. This apparatus is located in the northwest corner of the sedimentation and filtration room, 50 feet from the point of discharge of the chlorine into the water.

Clear-water reservoir. This is circular and covered. It is 90 feet in diameter and 20 feet deep, with a capacity of 700,000 gallons. It has a baffle wall 9 feet high to permit cleaning half the reservoir at a time. This cleaning is accomplished by using a siphon, as the reservoir is below river level.

Pumps. The high-service pumps which force the filtered water into the city mains are a 10,000,000-gallon Epping Carpenter used continually, a 6,000,000-gallon Holly for emergency use, and a 5,000,000-gallon Dean for emergency use. The Epping Carpenter pump has a 30-inch suction, while the Holly and Dean pumps use a common, 24-inch suction.

Venturi. All water leaving the plant is measured through a Venturi meter, 24 inches in diameter with a 10-inch throat.

Standpipe. The pressure in the city mains is 100 to 110 pounds, this being necessary to boost the water into a standpipe 1¼ miles from the plant. This standpipe is 118 feet high and is situated on a bluff 161 feet above the level of water works plant. It has a capacity of 500,000 gallons. It floats on the main all the time and is equipped with an electric gauge which has eliminated all danger of overflowing. The gauge is located at the plant and the mechanism at the standpipe; it indicates the quantity of water in the tank at all times. It has now been in satisfactory service for two years. It was designed by S. E. Buck, engineer at the plant, and F. H. Harrington, city electrician.

By-pass. The use of the by-pass does not mean that raw untreated water is sent into the mains, but that the river water goes through the regular alum treatment and sedimentation, skips the filters, is chlorinated, and is then passed into the clear-water reservoir.

Filters 3 and 4 have their sewer valves opened, allowing the water to flow over the weir of the sedimentation basin into the wash troughs and through the main leading to the sewer, but by opening the by-pass valve the water is turned into the regular main leading to the clear-water reservoir, on the way to which it is chlorinated.

Condition of plant. This plant has a number of problems to be worked out but the author has experienced no particular trouble in keeping up either the quantity or quality of the effluent. The water conforms to the U. S. Treasury Standard during most of the time and a fire of January 15, 1919, showed that the plant can meet any emergency demand up to the limits of its capacity. This fire lasted four hours; Venturi readings showed a pumping of 2,250,000 gallons and there was a reserve supply of water when the emergency was over.